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THE GENUS ANNONA IN THE HAWAIIAN ISLANDS

By Vaughan MacCaughey

The Annonas[1] or custard-apples comprise one of the best known and most highly prized groups of tropical fruits. Their rich, sweet, creamy flesh, abundantly juicy and with delicious aroma, is widely known throughout the tropics and subtropics of the world, both as a fresh fruit, and in the form of sherbets, ices, and preserves. Some of the most delicious fruits that are known to mankind belong to this interesting group.

The genus contains about sixty species, chiefly trees and shrubs. The majority of these are indigenous to tropical America, but a few are native to Africa. It is very interesting to note that although nearly all of the living species are indigenous to the New World, nine fossil Annonas have been discovered in the Tertiary deposits of Europe. A number of species are now in cultivation in warm countries throughout the world. None of the Annonas occur naturally in the Hawaiian flora, but several of the widely cultivated species just referred to were introduced in very early times, and have now become thoroughly established in Hawaiian gardens, and naturalized in some of the country districts.

The Hawaiian Islands lie just within the tropics, and are notably cooler than most tropical countries. Hence those Annonas that require a truly tropical environment do not attain

[1] The name *Annona* is Latin for "year's harvest" and was suggested by the Haitian name *Anon*, applied to one of the species. In the literature the name is commonly spelled *Anona*, but Linnæus used the double n, and *Annona* is the correct form.

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perfection in the Hawaiian Archipelago. Those species thrive best that require subtropical rather than tropical, conditions. The *Cherimoya* is the hardiest of the cultivated species, and requires a comparatively cool climate for optimum development.* The sour-sop, on the other hand, is very tender, and requires the warmth of tropical lowlands. The other species of horticultural importance are intermediate between these extremes.

The Hawaiian Islands are remarkable, not only for the very high endemicity of the indigenous flora, but also for the great diversity of the introduced flora. Plants have been brought in from all parts of the world, from the days of the first European explorers, down to the present time. These first explorers were Spaniards, and probably the earliest line of communication from the outside world to Hawaii was from Mexico and Central America, the home of many Annonas. Hence it is not surprising that the custard-apples became established in Hawaii at a relatively early date. The Spaniard, Don Marin, who settled in the islands near the close of the eighteenth century, was actively interested in tropical horticulture, and introduced many useful fruits and other plants.

The four species abundant in the Hawaiian Islands are *A. muricata*, *cheromolia*, *reticulata*, and *squamosa*. These are the forms most generally cultivated in other parts of the tropics. The genus *Annona* is characterized by two-ranked often pungent-aromatic, alternate leaves, without stipules; blade entire, leathery, and often punctate. The flowers are perfect; solitary or in clusters; rarely racemose; extra-axillary, often opposite the leaves, and sometimes subterminal; nodding. The calyx is usually gamosepalous, three-parted, deciduous. The petals are typically six, in two series; the outer valvate, fleshy, concave, converging, three-angled at the apex; in some species the inner series is reduced to small scales, or wholly lacking. Stamens numerous, crowded on the hemispheric receptacle; the filament is fleshy, and bears a pair of linear, parallel, contiguous anthers, united on its back; the anthers open extrorsely by a longitudinal

* See F. W. Popenoe, The Cherimoya in California, Journ. Econ. Bot. Pomona College, Vol. 2, 1912, pp. 277–300.

slit. The stamens are surmounted by an expanded, hood-like connective, which is truncate, and sometimes glandular.

The carpels are numerous, distinct or united; the ovaries usually covered with minute hairs, and containing a single erect basal ovule. The fruit is a syncarpium, formed by the growing together of the carpels and receptacle into a more or less globular fleshy fruit, the surface of which is smooth, scaly, or muricate. The seeds are numerous, with a brown, leathery-crustaceous testa, enclosed in an aril, and containing a large wrinkled endosperm with a small, basal embryo.

From a cultural standpoint the Commercial Annonas are alike in preferring a heavy loam soil; in being intolerant of stagnant water at the roots; in producing an abundance of seeds that germinate very readily; in showing considerable seed variation, so that the best results are almost obtained by shield-budding or cleft-grafting with known varieties; and in coming into bearing at a very early age, often in the third year.*

The *Annona* seen most commonly in the Honolulu markets is the sour-sop, *A. muricata* L. This species is cultivated throughout the tropics, and has a variety of names: guanabana, corossol, Coracao de rainha, graviola, suirsaak, zuursaak, laguana, and prickled apple.† The tree is small, evergreen, and begins to bear at a very early age. It is one of the tenderest of the Annonas, and thrives in the Hawaiian Islands only on the lowlands. It is abundant on all the islands around the native settlements, and in the gardens of white residents. There are many trees in Honolulu, and the fruit seems to be growing steadily in popular favor.

The young growth is scurfy-pubescent. The leaves are dark-green, obovate-oblong to ovate or elliptic, acute or abruptly acuminate, leathery, glossy above, rusty beneath, at length becoming glabrous; when crushed they are malodorous. The flowers are large, greenish-yellow; one to three, but usually soli-

* See P. J. Wester, Annonaceous Possibilities of the Plant Breeder, Philip. Agric. Rev., Vol. 6, 1913, pp. 312–321; also his Annonaceous Fruits and their Propagation, loc. cit., Vol. 5, 1912, pp. 298–304.

† See P. J. Webster, A Contribution to the History and Vernacular Nomenclature of the Cultivated Anonas, Philip. Journ. Sci., 7, Botany, 109–113. 1912.

tary, nodding, and with a distinct odor. The exterior petals are thick and fleshy, ovate-acute, valvate or edge-to-edge; the interior petals are somewhat smaller and thinner, concave, rounded, imbricate or overlapping, and yellowish, or sometimes reddish, in color.

The sour-sop fruit matures at all seasons, but is most abundant in the summer months. It is large, oblong or heart-shaped, sometimes blunt and conical; in weight it varies from one to fifteen pounds. The larger fruits are usually quite superior in texture and flavor to the small ones; the Oriental gardeners habitually pick the fruit before it has properly matured. The skin or rind is glossy, dark green, and studded with numerous recurved fleshy spines, which correspond to the carpels. The flesh or pulp is soft, white, and cotton-like in texture; it contains a large amount of juice, which is pleasantly subacid, with a slight mango-like or turpentiney flavor. The flesh separates readily into a number of fibrous sections, the carpels; each contains a single shining black seed, about a half-inch long. The copious juice of the sour-sop makes it a favorite fruit for the preparation of sherbets, punches, jellies, etc. Although not as sweet as some of the other Annonas, the sour-sop possesses a rich sugar content, and is by no means as tart as its name suggests. A closely related species, which does not occur in Hawaii, is the *Annona montana* MacF., the mountain sour-sop of Mexico and Central America. The fruit of this species is not edible, but the tree is used as a stock in Florida, as it is much hardier than the sour-sop. It would undoubtedly prove of distinct value in the Hawaiian Islands, as stock for growing the sour-sop at the higher elevations.

Several other species that are closely related to the sour-sop may be mentioned as worthy of introduction into the Hawaiian group. *Annona purpurea* M. & S., the "negro-head" of Mexico (also called Cabeza de Negro, Soncoya, and Toreto), is abundant on the Isthmus of Tehuantepec, and is commonly sold in the markets of Mexico and south to Panama. The fruit is six to eight inches in diameter, deeply and conspicuously muricate, with delicious fragrant flesh. *Annona diversifolia* Safford is another

excellent species that merits wider introduction. It is a small tree native to the west coast of Mexico, to Salvador, and is called "ilama" or "ilamatzapotl." The fruit is about six inches long and five inches broad, shaped and marked like a pineapple cheese. It is covered with a dense gray, felt-like tomentum; the flesh is cream or rose-colored and very finely flavored. This species has been introduced into southern Florida.

The Florida alligator-apple, *Annona glabra* L., may be mentioned at this point, as a very promising stock for the sour-sop, cherimoya, and custard-apple. It is a small to medium-sized tree, inhabiting swamps and marshy streamways in Florida, tropical America, the West Indies, the Galapagos Islands, and the west coast of Africa. It has a wider natural distribution than any other species in the genus. Other names are mamon, mangrove-annona, pond apple, corkwood. The light, spongy roots of this species are used as a substitute for cork. The fruit is smooth, the size and shape of an apple; the flesh is of buttery consistency, and very sweet, sometimes cloying. It is very common in the markets of Mexico City, but the fruit does not seem to be valued in Florida.

The second species that is abundant in the Hawaiian Islands is the cherimoya, *Annona cherimolia* Mill., also known as broad-leaved custard-apple, Jamaica apple, matzapotl, cherimoyer, etc. It is indigenous to Ecuador, Colombia, and Central America, but had been widely distributed throughout warm countries —Italy, southern France, Spain, northern Africa, Ceylon, Queensland, Florida, and southern California. It was introduced into the Hawaiian Islands in very early times, and is now naturalized, particularly in certain parts of the Kona and Ka-u districts, on the island of Hawaii. The cherimoya is essentially a *sub*-tropical fruit, and does not give good results in low tropical countries. It occurs in perfection on the great central plateau of Mexico. Its two most important climatic requirements are freedom from excessive humidity, and cool weather at the time of ripening.

The cherimoya is a tree ten to twenty-five feet high, with spreading branches and fulvo-tomentose young growth. The

leaves are dark green, shining, ovate or obovate, sometimes elliptical; sparsely hairy above, persistently velvety beneath; the apex is obtuse or obtusely acuminate, the base is rounded. The flowers are greenish, and very fragrant; extra-axillary, often opposite a leaf at the base of a branchlet; usually solitary, but sometimes two or three on short nodding tomentose peduncles. The exterior petals are oblong-linear, about an inch long, keeled on the inside and excavated at the base; greenish-yellow on the outside and covered with fine tomentum; pale yellowish or whitish within, and marked with a purple spot at the base. The inner petals are small, squamose, ovate or triangular; usually flesh-colored or purple, and keeled on the outside.

The fruit is about the size of a large orange, and variable in shape. It may be conoid, heart-shaped, or oblate. The young fruit is covered with brown tomentum. When ripe the rind is gray-green, smooth or slightly areolate, sometimes "having the appearance of putty marked by finger prints." The carpels may be depressed, smooth, or raised, sometimes knobby. The flesh is white, soft, richly flavored, and pleasantly acidulous. It is said that fruits of exquisite flavor are produced in Madeira, where the trees are trained on trellises. This species has given excellent response to cultivation in southern California. The cherimoyas are rarely seen in the Honolulu markets, but occur in many private gardens. There has been no commercial exploitation of the fruit.

The third species, *Annona reticulata* L., is not very common in the Islands, but may be found here and there in private gardens and old estates. This is the true custard-apple, also known as bullock's heart, corazon, mamon, anonas, and quauhtzapotl. It is a native of the West Indies and tropical America, and is now grown in many tropical countries. It has been cultivated successfully in southern Florida and southern California.

The tree is ten to twenty-five feet high, and in some regions is deciduous. The young growth is fulvo-tomentose. The leaves are lanceolate or oblong lanceolate; apex acuminate; glabrate above, sometimes rough beneath; light green and rather brittle. The flowers are yellowish or greenish, with purple spots; they

occur in extra-axillary clusters of several, emerging from the new branchlets; peduncles nodding. The outer petals are fleshy, oblong-linear, keeled on the inside and excavated at the base, olive-green or yellowish, usually stained with purple within, and with a dark purple blotch at the base. The inner petals are very small, scale-like, ovate, and acute. The carpels are distinct; the ovaries covered with pale brown silky hairs, at length uniting to form a solid fruit.

The custard-apple fruit, when mature, bears a striking superficial resemblance to a large heart, hence the name bullock's heart. It is three to five inches in diameter. The rind is smooth, with small rhomboid or hexagonal areoles. It changes in color from pinkish yellow through to reddish brown, and is covered with a whitish bloom. It ripens very slowly and the tree yields but one crop per year. The flesh is soft and creamy yellow, delicious in flavor, although cloying; in texture it is granular, and adheres closely to the seeds. These are smooth, and dark-brown, like those of the other species. The fruit is considered inferior to both the cherimoya and the sugar-apple. In Guam it is the favorite fruit of the native fruit-eating bat.

It is interesting to note that the custard-apple, although relatively uncommon in Hawaii, has spread spontaneously through the forests of Guam and the Philippines. It is essentially a tropical species, and Hawaii is undoubtedly too cool for its best development. The fruit is rarely seen in the Honolulu markets.

The last species that occurs in Hawaii is the sugar-apple, *Annona squamosa* L., also known as sweet-sop, atte, pomme-cannelle, annona blanca, ahate de panuco, and caneel-appel. This luscious fruit is more widely dispersed through the tropics and subtropics, and more generally cultivated, than any other species of the genus. It is native to the West Indies and tropical America, and is distinctly tropical; it does not thrive under subtropic conditions. However, it is common in many of the older Hawaiian gardens, not only in Honolulu, but also on the other islands of the group.

The tree is fifteen to twenty feet high, with irregularly spreading branches and conspicuously zigzag branchlets and twigs.

In some regions it is deciduous, but in Hawaii all the species are evergreen. The leaves are thin, ovate oblong, often asymmetrical; slightly hairy on both sides; pale green, and minutely punctate. Like the other species, the leaves are malodorous when bruised. The flowers are greenish, fragrant, about an inch long, and closely resemble those of *reticulata*. They occur in clusters of one to three, opposite the leaves, on slender pedicels. The sepals are small; the exterior petals greenish, white inside, with a purple blotch at the base; the inner petals inconspicuous.

The fruit is three or four inches in diameter; spheroid or heart-shaped, and somewhat resembles an artichoke. In color it is greenish yellow, sometimes shaded with pink or purple. Each carpel is free and protuberant, forming a squamose or tuberculate surface. The loosely cohering carpels are rounded at the end, and grooved on the inner side. The exterior is covered with an easily rubbed glaucous bloom; the fruit is tender and turns black in spots when handled. The flesh is creamy-white, sweet, custard-like, and very delicious. There is a very slight trace of fiber. There are numerous small, dark-brown seeds, as in the other species. The fruit is always used uncooked, and makes delicious sherbets. Unlike the custard-apple, the sweet-sop fruits several times a year.

In the West Indies the leaves, unripe fruits, and seeds are often powdered and mixed with flour of gram (*Cicer arietinum*) for use as a vermifuge; this use is not known in Hawaii. The fruits rarely appear on the markets in Honolulu, although the tree is by no means uncommon.

In conclusion mention may be made of two very fine, but little known annonaceous fruits, that should become known to fruit-growers in Hawaii and other tropical portions of the United States. *Rollinia orthopetala* A.DC., the biriba, and *R. emarginata* Schlecht, the mirim, both of Paraguay, Brazil, and Argentine, are trees bearing very delicious large fruits. Those of the biriba attain a diameter of six or eight inches, and have been pronounced to be the finest annonaceous fruit of tropical America. They are practically unknown in North American markets.

As progress is made in our knowledge of tropical botany and

horticulture, the annonaceous fruits will unquestionably come to have a high place in the horticulture of the continental and insular tropic regions of the United States.

COLLEGE OF HAWAII,
HONOLULU, HAWAII

"PEANUTS!"

BY BYRON D. HALSTED

Peanuts have been grown in the experiment grounds for the past two seasons and a few plants have occupied space in the greenhouse, that we might get in closer touch with this peculiar crop.

The peanut while young does not appear to be fond of its job, as one may judge from the poise of its wings (cotyledons) and the unkempt conditions of its tail feathers (plumular leaves). But later on when it gets its second wind, it goes forward with a fair degree of speed and decorum barring a seeming absurdity in locating its fruit underground.

In the peanut the parts seem to have been assembled with much trepidation and one wonders what may be added (or taken away) before the end is reached. As an instance, the leaflets seem to be unfinished at their tips and furthermore it is here that a "burn" is quite sure to locate and give the foliage the suggestion of maturity and the advent of autumn long before its time. Again the leaf has an air of decapitation, ending, as it does, in a pair of flaunting leaflets, there usually being but two pairs when all are counted. Still further the stipules are so long, hairy and closely appressed that one wonders whether they are worn for looks or to hide an abashed stem.

In about thirty days after planting the flowers make their appearance and are like gold-foil spangles among the nondescript stipules. Some day some one may have something more to say concerning these auriferous blooms, but for the present attention must be drawn to the fruits that follow.

To start again the peanut as one gets it at the store or entrance to the park for either home or street or menagerial consumption